CALIFORNIA
ENERGY
COMMISSION

FORECASTS OF CALIFORNIA TRANSPORTATION ENERGY DEMAND, 2003-2023

Prepared in Support of the *Transportation Report* under the Integrated Energy Policy Report Proceeding, Docket # 02-IEP-01

Draft Staff Report

JUNE 23, 2003
600-03-009SR

Gray Davis, *Governor*

CALIFORNIA ENERGY COMMISSION

Chris Kavalec,
Principal Author

Charles Mizutani,
Project Manager

Pat Perez,
Manager
TRANSPORTATION FUEL SUPPLY & DEMAND OFFICE

Scott W. Matthews,
Deputy Director
TRANSPORTATION ENERGY DIVISION

Robert L. Therkelsen
Executive Director

TABLE OF CONTENTS

Forecasts of California Transportation Energy Demand

Introduction

Senate Bill 1389 (SB 1389, Bowen, Chapter 568, Statutes of 2002) requires the California Energy Commission (Energy Commission) to adopt an Integrated Energy Policy Report (IEPR) every two years. The first report is due to the Governor and Legislature in November 2003. Senate Bill 1389 requires the Energy Commission to conduct transportation forecasting and assessment activities including forecasts of transportation energy demand to support preparation of the IEPR.

In response to SB 1389, this staff report presents forecasts of energy demand in California for on-road car and truck use, commercial aviation and transit. These uses account for about 87 percent of the state's transportation energy use. The largest other use, residual fuel for shipping, typically accounts for 5-10 percent of energy use in transportation.

California's Historical Demand for Transportation Energy

From 1980 through 2000, California's population grew by an average of 1.9 percent per year, and the number of on-road vehicles grew at nearly the same rate. Due in part to rising, real per-capita income, total on-road travel in the state increased at a significantly higher rate than either population or vehicles—an average of 3.3 percent annually while, at the same time, gasoline and diesel demand increased by an average of just 1.8 percent.

The fact that travel has increased at almost twice the rate of population growth is also explained by two phenomena: declining real gasoline prices and rapidly rising vehicle fuel economy. Since 1980, the real cost of gasoline has dropped by 40 percent while fleet-average fuel economy has nearly doubled.[i] As a result, the average per-mile cost of gasoline is less than one-half of what it was in 1980. Figure 1 shows the average per mile cost (in $2000) of operating a gasoline-powered light-duty vehicle (LDV) over the period from 1980 to 2002.

Figure 1: Average per-Mile Cost of Gasoline, 1980-2002

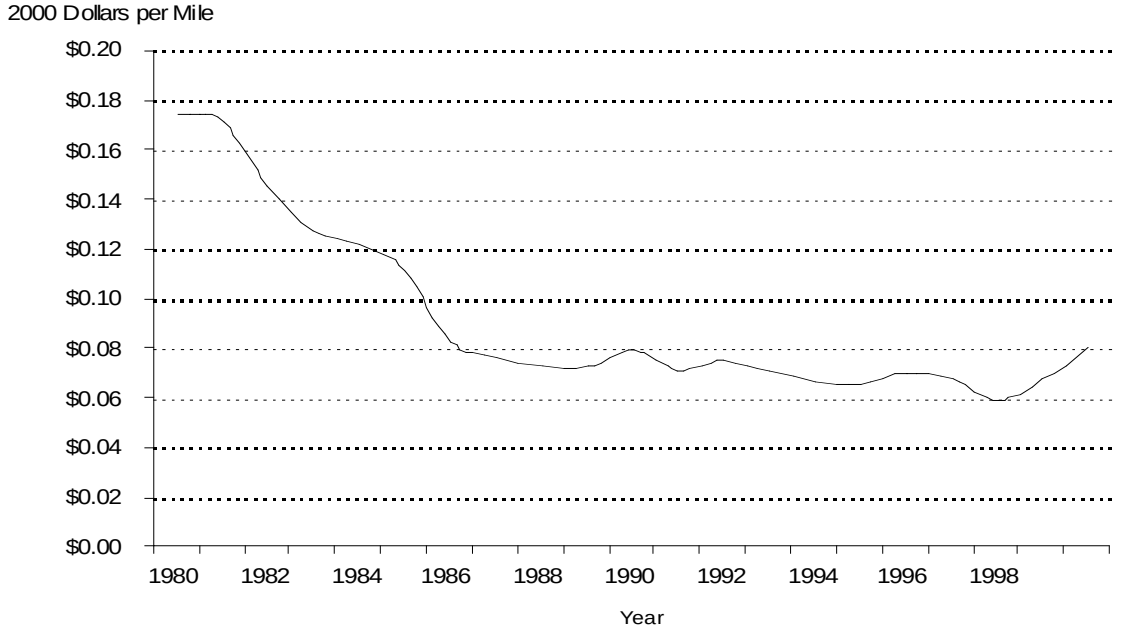


Figure 2 shows the slate of petroleum fuels Californians consumed from 1985 through 1999.[ii] The decline in petroleum demand during the late 1980s and early 1990s and the resumption of demand growth in the middle 1990s are indicative of the way economic activity affects transportation demand; these patterns closely follow California's economic conditions in the post Cold War era.

Figure 2: Demand for Petroleum-Based Transportation Fuel in California, 1985-1999

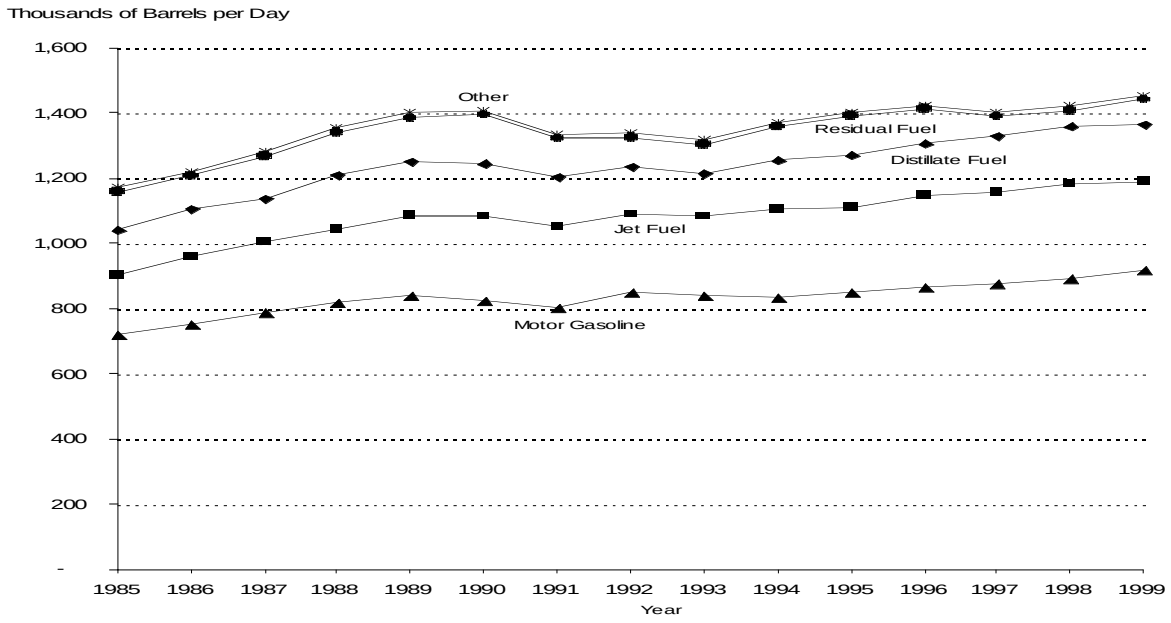


Table 1 shows that the demand for motor gasoline in 2000 exceeded that of jet fuel, the second largest use, by a factor of three. Distillate, primarily diesel, is used for both on-road and off-road vehicles. On-road vehicles use about 90 percent, and railroad applications use another 8 percent of the distillate consumed in California.[iii]

Table 1: California Petroleum Demand in the Transportation Sector—2000

Fuel Type	Percent	Thousands of Barrels per Day
Motor Gasoline	61.1%	933
Jet Fuel	18.4%	282
Distillate	12.5%	191
Residual	7.3%	112
Other	0.7%	11
Total	100.0%	1,529

LDVs include automobiles, and pickup trucks, vans, and sport utility vehicles (SUVs) that are collectively termed “light trucks.” LDVs account for nearly all of California’s on-road passenger movement. In 2002, Californians registered about 24 million gasoline-powered vehicles. Small fleets of liquefied petroleum gas, natural gas, alcohol, and electric vehicles, cumulatively totaling about 120,000 (or approximately six-tenths of 1 percent of the vehicle population), also operate in California. In 2001, Californians purchased 1,078,000 new cars and 971,000 new light trucks. Commercial fleet vehicles account for about one-third of these purchases.

The average fuel economy of gasoline-powered LDVs has steadily increased since the mid-seventies from about 12.6 miles per gallon to today’s 20.6 miles per gallon. However, consumers’ growing preference for light trucks, particularly minivans and SUVs, which have lower average fuel economy, has caused fleet-average fuel economy to level off for the first time since 1973.

Heavy-duty vehicles (HDVs) include medium and heavy-duty trucks and buses. Most HDVs provide on-road freight movement; a much smaller number transport passengers. There are about 867,000 HDVs registered in California (HDVs are generally defined as those vehicles that weigh over 10,000 pounds), which use approximately 2.6 billion gallons of diesel and 0.7 billion gallons of gasoline annually.

Key Factors Affecting Future Transportation Energy Demand

Economic conditions and population growth are the primary drivers of transportation energy demand. Using California Department of Finance projections, the Energy Commission assumes that California's population will grow by an average of 1.4 percent per year over the next 20 years. This translates to 12 million more Californians by 2023—slightly below the average annual rate of the last 20 years, reflecting an aging of

the large “baby boom” generation. Average household size is projected to increase, so that total households grow at a lower rate than population, an average of 1.2 percent per year. The Energy Commission assumes that unemployment in the state will remain relatively low (i.e. around 5 percent) over the next 20 years and real per-household income will grow at an average annual rate of about 2.5 percent, slightly higher than in the past 20 years.

Base-Case Forecast Methodology

To develop a transportation energy demand forecast (including jet fuel, gasoline, diesel, electricity, and natural gas), the Energy Commission has forecasted the number of aircraft passengers, vehicle miles traveled (VMT) and the number and characteristics of cars, trucks, buses, and light-rail transit vehicles. The gasoline and diesel demand forecast covers freight, transit, and LDV consumption.

Forecasting Models

The Energy Commission uses the California Conventional Alternative Fuels Response Simulator (CALCARS) model to forecast vehicle stock, VMT, and fuel consumption for personal cars and light-duty trucks in California. Currently, the model can accommodate up to 45 classes of vehicles and 17 vintages (model years). CALCARS was recently re-estimated to incorporate diesel and electric hybrid vehicles using vehicle choice data collected during the Energy Commission’s California Vehicle Survey.

The Freight Model projects the volume of freight transported by truck and rail; truck stock and VMT; and the truck and rail consumption of gasoline and diesel. The model is driven by projections of industrial activity in the region or statewide, by economic sector. In addition, it provides projections for commercial LDVs. These projections are combined with those from CALCARS to forecast total (commercial plus personal) LDV fuel use and vehicle miles traveled.

The transit forecast includes transit activity and energy demand for urban bus and rail systems, intercity bus and rail systems, school buses, and other buses (charter, church, etc.). Fuel use is projected for diesel, gasoline, electricity, and natural gas.

The Commercial Aviation Model forecasts annual commercial jet fuel demand. The energy forecast is driven by projections of passenger trips on commercial airlines, which are specified as a function of personal income and average airline cost of travel per mile.

Assumptions Underlying the Base Case Forecast

Historical and projected vehicle characteristics (purchase price, mile per gallon (mpg), etc.) are provided by K.G. Duleep of Energy and Environmental Analysis, Inc. The base case forecast assumes significant availability and use of hybrid electric gasoline vehicles; hybrid-electric vehicle penetration levels are assumed to be consistent with the California Air Resources Board advanced technology partial zero emission vehicle requirements, part of the current zero emission vehicle mandate. To meet these

requirements, personal hybrid vehicles were forecast using the number of makes and models projected by K.G. Duleep through 2014, along with five percent penetration in commercial fleets. From 2015 onward, hybrid makes and models available were assumed to increase by 50 percent.[iv] Diesel LDVs were assumed to be available in California starting in 2007.

Fuel efficiency (by class) for gasoline LDVs is projected to decline slightly until model year 2007 or 2008, reflecting recent trends, and then begin to increase. As an example, compact car mpg declines from 26.0 to 25.85 between 2003 and 2008, and then reaches 26.3 mpg by 2020.

The Energy Commission's base-case forecast assumes gasoline prices of $1.68 per gallon (in 2003 dollars) beginning in 2004. The price for on-road diesel is projected to be $1.63 in 2004 and 2005, and $1.67 from 2006 onward. These projections are based on a long-term world crude oil price of $25.00 per barrel. In addition, the Energy Commission assumes that smaller sport and cross utility vehicles will continue to increase as a percentage of new LDV sales through 2010, using the increase in makes and models projected by K.G. Duleep.

The forecast of jet fuel demand is based on projecting growth of commercial aviation passenger volume in California from 159 million in 2000 to 366 million in 2023. Although commercial aviation travel in California declined about 10 percent between 2000 and 2002, staff assumed that airline travel will resume historical growth rates beginning in 2003.[v] Base-case projections for electricity and compressed natural gas (CNG) demand include transit as well as light-duty applications.

Base Case Forecasting Results

The Energy Commission projects that on-road VMT (LDVs, freight, and transit) will increase in California from 313 billion miles in 2002 to 362 billion miles in 2010 to over 440 billion by 2023. This represents an average increase of 1.65 percent per year over the forecast period. Light-duty vehicle VMT, which makes up about 95 percent of the total, is expected to increase from 294 to almost 420 billion miles over the forecast period, a rate of 1.7 percent per year. Figure 3 shows the projected trend in VMT for LDVs and all uses combined.

By 2023, the Energy Commission projects that the number of on-road vehicles will reach over 33 million in California, up from about 24.4 million in 2002 (of which over 97 percent are LDVs), an average growth rate of 1.45 percent per year. Primarily due to the continued growth in the smaller sport and cross utility vehicles, the forecast projects that light trucks will continue to increase as a fraction of LDV stock in California, making up over 44 percent by 2023, up from 41 percent in 2002. In spite of this growth, the base case assumptions for slight fuel economy growth in conventional gasoline vehicles after 2008, the significant penetration levels projected for electric hybrids, and the availability of light-duty diesels yield a forecast that shows LDV fleet-average fuel economy increasing by 2.4 percent over the forecast period, from 20.6 mpg in 2002 to 21.1 mpg in 2020.

The Energy Commission's base-case forecast projects on-road gasoline demand to increase from 15.0 billion gallons in 2002 to 17.3 billion gallons in 2010 and to 19.8 billion gallons by 2023. Jet fuel demand is projected to increase from 4.1 billion gallons in 2002 to 5.6 billion gallons in 2010 and to 9.1 billion gallons by 2023. Diesel demand is projected to increase from 2.6 billion gallons in 2000 to 3.2 billion gallons in 2010 and to 3.9 billion gallons by 2023. These forecasts translate to an average increase of about 1.35 percent per year for gasoline, 3.95 percent annually for jet fuel and about 1.9 percent for diesel. Figure 4 shows projected demand for on-road gasoline and diesel and for jet fuel.

Electric hybrid vehicles sales are projected to increase from 5,300 in 2002 to 144,000 in 2010 to 259,000 by 2020 (about 9 percent of total sales). For light-duty diesels, sales are projected to reach 56,000 in 2010 and 70,000 by 2023. The fleet penetration of hybrids and diesels serves to reduce LDV gasoline demand projections by almost 1 billion gallons per year by the end of the forecast period, as shown in Figure 5. Without hybrids and light-duty diesels, the projected growth rate for gasoline demand from 2003-2023 would average 1.55 percent per year.

Demand for electricity in the transportation sector is expected to grow from 660 to 2,000 million kilowatt-hours between 2002 and 2023. During the same period, demand for natural gas in on-road vehicles will increase from 62 to 250 million therms.

Figure 3: Projected On-road VMT, 2003-2023

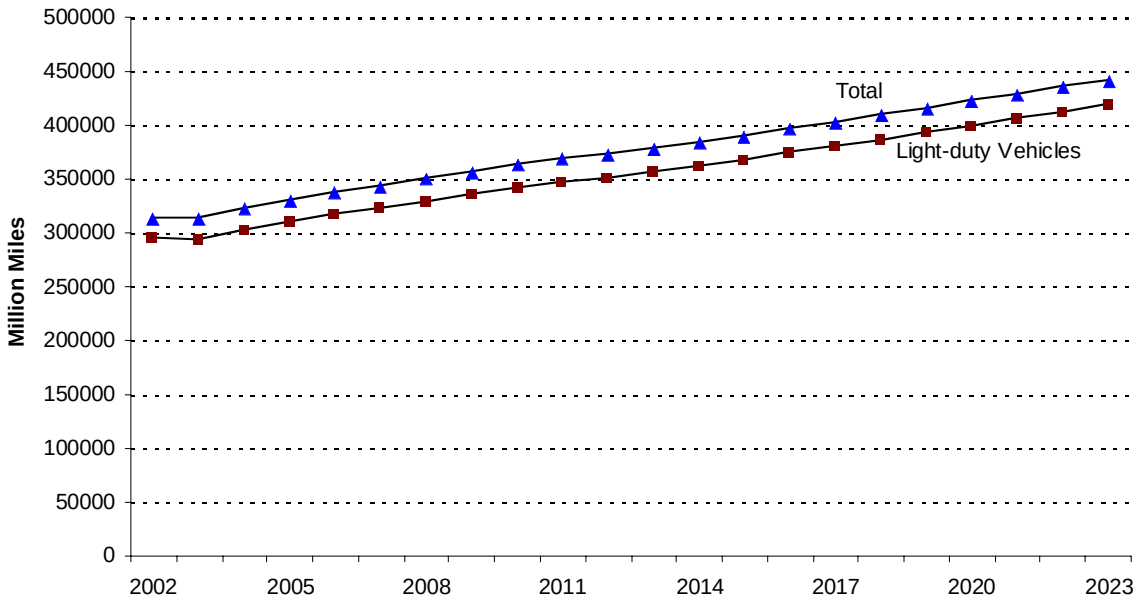


Figure 4: Projected On-road Gasoline and Diesel Use, 2003-2023

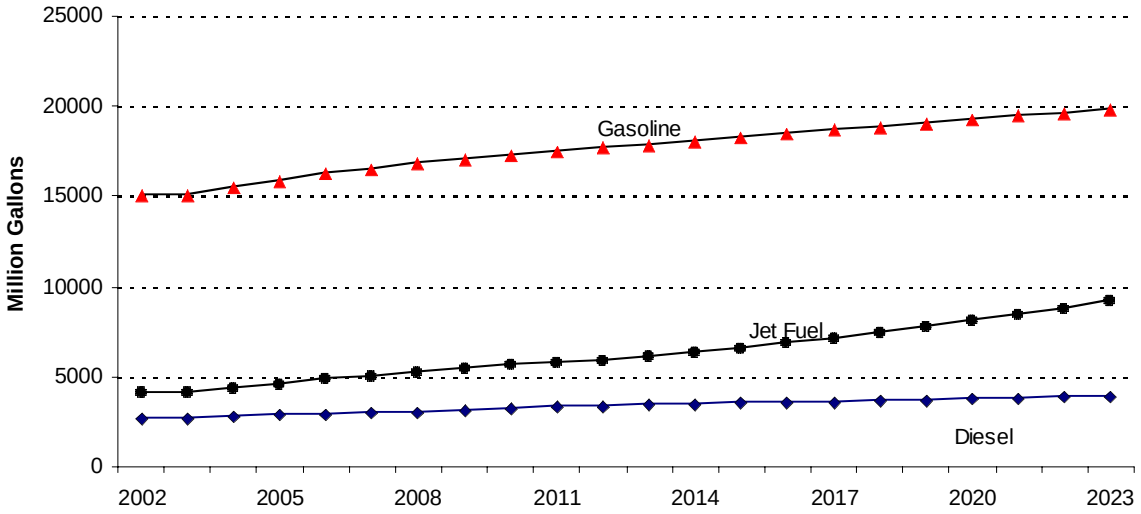
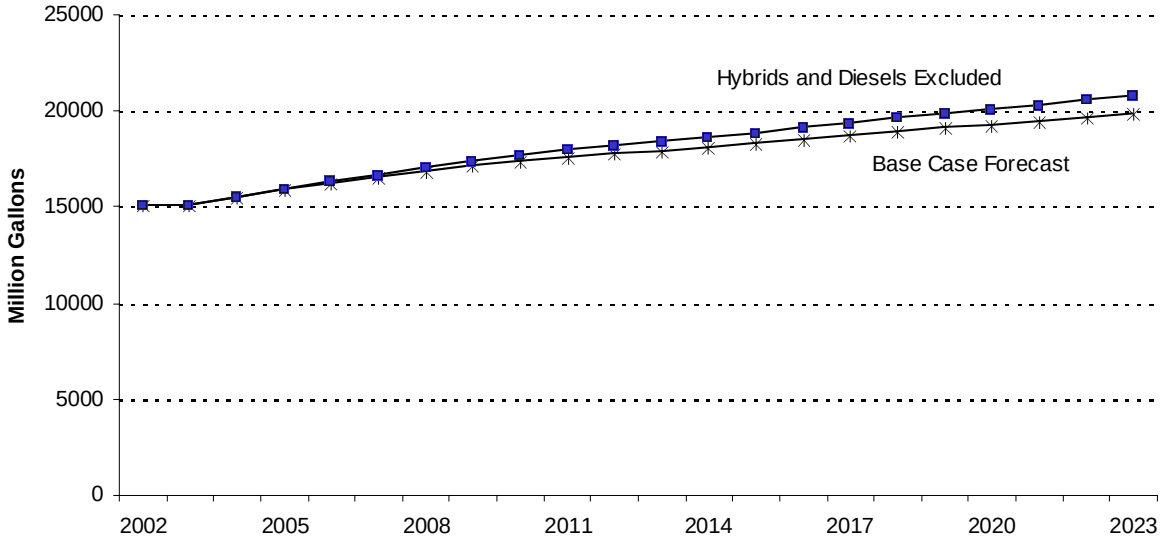


Figure 5: Impact of Hybrids and Light-Duty Diesels on Projected Gasoline Demand



[i] Note that fuel cost per mile is equal to the price per unit of fuel divided by fuel efficiency (miles traveled per unit of fuel).
[ii] Energy Information Administration, U.S. Department of Energy, State Energy Data [eia.doc.gov/eneu/states].
[iii] Based upon data from the Energy Information Administration, U.S. Department of Energy, *Fuel Oil and Kerosene Sales 1998*, Tables 23 and 24, Washington, D.C., August 1999.
[iv] From 2014 to 2015, the required sales of hybrids increase by almost 60,000, a requirement that would not be met according to the CALCARS model without increasing the makes and models available.
[v] This assumption is consistent with the most recent Federal Aviation Administration forecast (source: *FAA Aerospace Forecast, Fiscal Years 2003-2014*, March 2003).